Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION
and CONFERENCE REPORT

Columbia River Federal Navigation Channel Deepening

Agency: U.S. Army Corps of Engineers - Portland District

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: December 16, 1999

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I. BACKGROUND

The U.S. Army Corps of Engineers (Corps) maintains the Federal Navigation Channel in the Columbia River through operation and maintenance dredging. Currently, the navigation channel is maintained at an average depth of 40 feet in depth with 5 feet advanced maintenance dredging. The Corps and several port districts along the Lower Columbia River are proposing to deepen the channel**,** by as much as three feet, from the City of Portland to the mouth of the Columbia River to facilitate maximum usage by outbound loaded vessels. The project would not deepen the entire stretch of the river from Portland to the mouth, because significant stretches of the river are already at the targeted depth of 43 feet.

In an April 5, 1999, Biological Assessment (BA) for the proposed deepening project, the Corps requested formal consultation based on their determination that the proposed action may affect, but is not likely to jeopardize the continued existence of Pacific salmon species listed and proposed for listing. The NMFS worked with the Corps to identify further information regarding the anticipated effects of the proposed action on the listed species for several months. On August 25, 1999, upon receipt of the Final Environmental Impact Statement (FEIS), NMFS determined there was sufficient information to initiate formal consultations and began to prepare this Biological and Conference Opinion (BO). On December 3, 1999, the Corps amended its Biological Assessment to include additional conservation actions, including research, ecological restoration and monitoring.

The objective of this Biological Opinion is to determine whether deepening the identified segments of the Federal Navigation Channel is likely to jeopardize the continued existence of salmonid species listed or proposed for listing under the Endangered Species Act (ESA) [Table 1], or result in the destruction or adverse modification of their designated or proposed critical habitat. This Opinion also documents consultations under the Magnuson-Stevens Act of 1996.[1]

Previous consultations have been conducted on the Corps's Operation and Maintenance Dredging activities, including: an August 1, 1991, informal consultation for use of Interim Area D Estuarine Disposal Site in Clatsop County, Oregon; a February 25, 1992, informal consultation for construction of the Wahkiakum Ferry Channel at Puget Island, Washington; a March 5, 1992, informal consultation for emergency dredging sites in the Columbia River; a December 11, 1992, informal consultation for expansion of Columbia River dredged material disposal sites; a November 5, 1993, informal consultation for Dungeness crab entrainment studies in Baker Bay, Washington; a December 22, 1993, formal consultation on Columbia River operation and

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[1]Public Law 104-267, the Sustainable Fisheries Act of 1996, ammended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in federal fishery management plans (FMPs) and to require federal agencies to consult with NMFS on activities that may adversely affect EFH. Under section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide discretionary EFH conservation and enhancement recommendations to federal and state agencies for actions that may adversely affect EFH. However, state agencies and private parties are not required to consult with NMFS unless state or private actions require a federal permit or receive federal funding.

maintenance dredging; a September 14, 1994, reinitiation of the December 22, 1993 formal consultation to address designated critical habitat; an April 6, 1996, informal consultation on hopper and pipeline dredging in the Columbia River; a September 22, 1995, formal consultation on repair of pile dikes in the Lower Columbia River; a July 25, 1996, reinitiation of the September 22 formal consultation to address additional pile dikes; an August 2, 1996, informal consultation on replacement of a navigational aid in the Lower Columbia River; a May 28, 1998, informal consultation for the maintenance dredging program to address listing of Snake River and Upper Columbia River steelhead; a May 27,1999, informal consultation to begin dredging operations at the mouth of the Columbia River; and a September 15, 1999, formal consultation on operation and maintenance dredging from John Day Dam to the mouth of the Columbia River. In addition, NMFS commented (March 24, 1997) on the Dredged Material Management Plan and on the proposed Channel Deepening Project (March 24, 1997 and February 2, 1999).

Table 1: Species Considered in this Biological Opinion

Common Name	**Scientific Name**	**Listing Status**
Snake River sockeye salmon	*Oncorhynchus nerka*	Listed (Endangered)
Snake River spring/summer chinook salmon	*O. tshawytscha*	Listed (Threatened)
Snake River fall chinook salmon	*O. tshawytscha*	Listed (Threatened)
Lower Columbia River steelhead	*O. mykiss*	Listed (Threatened)
Upper Columbia River steelhead	*O. mykiss*	Listed (Endangered)
Snake River steelhead	*O. mykiss*	Listed (Threatened)
Upper Willamette River steelhead	*O. mykiss*	Listed (Threatened)
Middle Columbia River steelhead	*O. mykiss*	Listed (Threatened)
Columbia River chum salmon	*O. keta*	Listed (Threatened)
Lower Columbia River chinook salmon	*O. tshawytscha*	Listed (Threatened)
Upper Willamette River chinook salmon	*O. tshawytscha*	Listed (Threatened)
Upper Columbia River spring run chinook salmon	*O. tshawytscha*	Listed (Endangered)
Southwestern WA/Columbia River coastal cutthroat trout	*O. clarki clarki*	Proposed (Threatened)

II. DESCRIPTION OF THE PROPOSED ACTION

The U.S. Army Corps of Engineers proposes to deepen and continue to maintain the authorized Federal Navigational Channel in the Columbia River from River Mile (RM) 3.0 to RM 106.5 on the Columbia River (the Interstate 5 bridge crosses the Columbia River)[2]. The proposed action would generally deepen the currently authorized depth of 40 feet to a 43 foot depth with an advanced maintenance overdredge of 5 feet. The typical width of the navigational channel will be 600 feet, the same as the existing channel. As noted previously, the project would not deepen the entire stretch of the Columbia River from Portland to the mouth because significant stretches of the lower Columbia River are already at the targeted depth of 43 feet. Dredging would be conducted through a combination of dredging methods (hopper, pipeline, and clamshell dredges). The non-federal sponsors for the proposed action are the Ports of Portland, St. Helens, and Astoria, in the State of Oregon; and the Ports of Longview, Kalama, Woodland, and Vancouver in the State of Washington.

Construction of the proposed 43-foot channel would require 19.1 million cubic yards of dredging and the removal of 220,000 cubic yards of basalt rock, as well as 450,000 cubic yards of gravel and boulders. The Corps proposes the following amounts of material to be disposed of as a result of channel deepening:

- 37 million cubic yards of dredged material from below river mile 30 to be deposited on approved ocean disposal sites at the mouth of the Columbia River over a 50 year period; and
- 15 million cubic yards of dredged material from new work construction for above river mile 30 with 12 million cubic yards to be deposited in upland sites and 3 million cubic yards to be disposed in in-water sites.

Disposal of the dredged material would occur at ocean disposal sites, flow lane sites (throughout the channel in waters between 45 to 65 feet deep and along the North Jetty), numerous upland sites, and one beach nourishment site at Miller Sands. Because of concerns about the effect of material disposal on fisheries habitat, the shoreline disposal is proposed for only two locations: Miller Sands and Sand Island.

Disposal in flow lane sites will generally occur in waters 45 to 65 feet in depth. However, between river miles 64 and 68 and river miles 90 and 101, disposal will occur in depths between 35 and 65 feet. Disposal will occur in waters deeper than 65 feet between river miles 30 and 38, between 54 and 56 river miles on the Oregon side of the channel only, between river miles 72.2 and 73.2 on the Washington side of the channel only, and at river mile 3 at the end of the Jetty A

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[2]Initially the Corps had proposed to also deepen the Willamette River as part of this project. Because of concerns with contaminants, dredging in the Willamette River is not being considered as part of the proposed action at this time. Once those issues have ben resolved, the Corps may consider deepening the Willamette River. A separate consultation would be required with NMFS under the Endangered Species Act for that project action.

site. These deep sites are non-erosive and will eventually be filled. Depth after 20 years of deposition will still be greater than 65 feet. In addition to the ocean disposal sites, the Corps is considering 31 upland disposal sites along the channel, with a total land area of 1,895 acres and a disposal volume of 64.5 million cubic yards.

To complete the dredging in the most expeditious and economical fashion possible, the Corps has proposed to construct the project over a 2 to 2.5-year period on a continuous basis. There are no timing restrictions proposed for this project. Currently, maintenance dredging also occurs on a more or less continuous basis.

Action Area

An action area is defined by NMFS regulations (50 CFR Part 402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved by the action". The action area for the proposed action is the mouth of the Columbia River (including the marine limits of the Columbia River estuary) upstream to the Interstate 5 bridge at the City of Portland. This area serves as a migratory corridor for both adult and juvenile stages of all listed and proposed species under consideration in this Biological Opinion. The action area is within critical habitat for the designated species as indicated by references cited in Table 2 under the Endangered Species Act, as well as within essential fish habitat (EFH) for commercially-managed chinook and coho salmon designated species, pursuant to the Magnuson-Stevens Act.

Amendments to the Proposed Action

On December 3, 1999, the Corps amended its Biological Assessment to include the following measures:

I. Corps and NMFS Research and Restoration

A. Research

The Portland District is proposing a new reconnaissance study for 2001 to attempt to address in a comprehensive manner the issues associated with watershed and estuary health in the lower Columbia River. The Corps'goal is to design this study to identify appropriate measures that will address the historic problem of loss of wetland/marsh habitat and other issues concerning the proper functioning of this ecosystem. Furthermore, the Corps now has under the Water Resource Development Act ("WRDA") of 1999 authority to "accelerate research and development activities" to include estuary and near ocean. The Corps has authority under Section 1135 of the 1986 WRDA and Section 206 of the 1996 WRDA to undertake environmental restoration. The Corps' goal is to use those authorities, working with NMFS, to identify and address information needs that will generate data that will allow them to prescribe needed habitat improvements for the Columbia River Estuary. The Corps proposes to use these authorities to monitor and evaluate the effectiveness of measures described in the December 3 Biological Assessment amendments.

B. Restoration

The Lower Columbia River Estuary Plan goal of restoring tidal wetlands is 1,500 acres by 2010 and 3,000 acres or more by 2020. The Corps proposes to expedite these objectives by restoring 1,500 acres of tidal wetlands by 2005, and 3000 acres between 2005 and 2010, subject to congressional authority and appropriation. In addition, within (5) five years, the Corps, in collaboration with NMFS, agree to an expedited establishment of 750 acres of tidal wetlands or other habitat that would contribute to macrodetrital production. The Corps will pursue this work as part of its ecosystem restoration mission and responsibility under separate authority, independent of the Channel Improvement Project. [Note: If activities described in paragraphs II. A, B and C, below, are funded and implemented as part of this effort, the Corps reserves the right to implement them or any portion of them under their broader statutory authority.]

II. Columbia River Channel Improvement Project Conservation Measures

A. Studies

1. Ecological Assessment of the estuary which identifies potential additional conservation recommendations which might facilitate the recovery of listed salmonid species: By November of 2000, the Corps, in consultation with the NMFS, will develop a plan of studies, focused on verification of the ecology of salmon in the shallow freshwater and brackish marsh habitats of the Columbia River Estuary.

2. Within six (6) months of the issuance by the Corps of the Record of Decision ("ROD") for the Channel Improvement Project, the Corps will develop, in consultation with the NMFS, a monitoring program to:

   a. Monitor physical and ecological changes during the construction phase of the Project;

   b. Monitor physical and ecological changes associated with the Project in the portion of the action area that is in the Estuary for (3) three years after completion of construction, and integrate ongoing monitoring into activities identified in I. A. above.

   c. Monitor the effectiveness of fish protection and habitat restoration activities listed below, for (1) year after completion of construction or implementation of the activity, and integrate ongoing monitoring into activities identified in I. A. above. [Note: The NMFS and the Corps will establish a post-project baseline, based upon the monitoring results, so that long term trends in the Estuary can be monitored and cumulative effects, if any, of future projects can be reviewed.]

3. Considerations in developing the studies may include, for example:

   a. Physical parameters and biological effects of alterations of the flow regime caused by the proposed action;

   b. Biophysical and ecological effects of any resultant salinity change on plant and animal communities and associated food web dynamics, with emphasis on rearing conditions at specific habitat locations and times that support juvenile salmonids;

   c. The need, if any, for further salinity intrusion modeling to address specific salinity and physical changes in identified critical areas in the estuary;

   d. The monitoring of salmonid population and life history responses, to consider:

      1) using untreated controls to compare with restored habitats, as well as monitoring responses before and after treatment;

      2) assessing the extent to which channel deepening and flow regulation interact to affect salinity conditions and the manner in which juvenile salmon use natural and restored estuarine habitats; and

      3) appropriate indicators of physical and biological change.

4. The Corps will participate in the ongoing development of freshwater sediment quality guidelines (screening levels) with acute, chronic, and bioaccumulative endpoints. The Corps will work with the NMFS and others regarding adoption of these freshwater screening levels into the Dredged Material Evaluation Framework for the Lower Columbia River Management Area.

5. The Corps will conduct, in consultation with the NMFS, surveys of potential juvenile salmon stranding in the lower Columbia River for the period of five (5) years, following project construction.

B. Ecological Restoration:

1. Within two (2) years of the issuance of the ROD by the Corps, the Corps will prepare a multi-year plan for Estuary Restoration, to address the elements listed below, with NMFS, appropriate Tribes, the Lower Columbia River Estuary Program and others that the Corps may identify as appropriate.

2. The Corps will implement retrofits at tide gates, opening 39 miles of salmon spawning habitat, as specified in section 4.8.2 of volume I of the August, 1999 *Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement*, p. 4-74.

3. The Corps will make improvements in embayment circulation, restoring connection to 335 acres of estuarine habitat, as specified in section 4.83 of volume I of the August, 1999 Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement, p. 4-75.

4. Once avian predation is managed and if consistent with the plan in B.1., above, the Corps will construct the Miller-Pillar Project or equivalent, thereby creating approximately 250 acres of shallow water habitat.

5. Within one (1) year of signing the Record of Decision, in consultation with NMFS, the Lower Columbia River Estuary Program, appropriate Tribes and others that the Corps may identify as appropriate, the Corps will identify and prioritize additional areas where shallow water habitat, low velocity wetlands, and other productive estuarine habitat may be created or restored. The plan will identify the appropriate mechanism to effect identified restoration implementation within (5) five years. The goal of this new work would be to find ways to restore the spatial and temporal diversity and connectivity of habitats available for juvenile rearing, and restore natural circulation and detrital trapping, macrodetrital food webs and other properly functioning ecological conditions. Specific actions may include:

    a. removing dikes along the tidal-freshwater flood plan, and reconnecting isolated backwater channels, sloughs and oxbows;

    b. recovering diked estuarine wetlands by removing dikes and floodgates and filling borrow ditches;

c. reconnecting peripheral upland drainages and freshwater inflow by removing armored channels, culverts, diversions, derelict pile dikes and other unnecessary structures that contribute to channelization;

d. removing inter-tidal fills and piling fields;

e. allowing large woody debris to naturally accumulate and structurally contribute to wetlands;

f. removing armor from shorelines.

C. Physical Protections:

1. The Corps will place the discharge pipe deeper than 20 feet during flowlane disposal.

2. The Corps will operate hydraulic dredges with the intake at or below the surface of the material being removed. The intake may be raised a maximum of three feet above the bed for brief periods of purging or flushing of the intake system. At no time would the dredge be operated at a level higher than three feet above the bed. This would include water being taken in to flush the dredge during disposal.

3. The Corps will work with NMFS, the U.S. Coast Guard, and the river pilots to develop vessel speed limits that would reduce the potential for stranding of juvenile salmon from ship wakes and exacerbate riverbank erosion.

4. The Corps will take no action, directly or by contract, by which dredge spoils would diminish the ecological function of flood plains or wetland habitat outside the channel, beyond that identified in the Environmental Impact Statement, or otherwise permitted following separate consultation with NMFS.

The Corps also proposes to implement an annual reporting process to NMFS to address the results of verification studies, ecosystem restoration actions, and project status, beginning one year from the date of issuance of the ROD. Before initiating dredging, the Corps will discuss the status of work identified above. At the end of the construction period, the Corps will evaluate with the NMFS the status of activities defined above. The Corps believes that a close working relationship during project implementation will ensure the implementation of appropriate conservation measures to protect and enhance listed stocks of anadromous fish. Regarding the direction of activities to address overall estuarine health, the Corps proposes a meeting in January 2000, to further scope these activities in coordination with the NMFS.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

NMFS has determined that the proposed action has the potential to adversely affect the species in the following Table 2 that have been provided protection under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*: ESA), although the effect is unquantifiable. Background on listing status and biological information on the species included in this Biological Opinion can also be found in Table 2. Based on migratory timing, it is likely that adult and juvenile salmon and steelhead of listed or proposed species would be present in the action area during the proposed dredging operations.

Essential features of designated or proposed critical habitat, or, proposed essential fish habitat, within the action area that involve support of successful migration, smoltification, and rearing for the species include: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (primarily juvenile), (8) riparian vegetation, (9) space, and (10) safe passage conditions. The proposed project may affect the following essential features: substrate, water quality, food, riparian vegetation and safe passage conditions resulting from dredging activities.

Table 2. References for additional background on listing status, biological information, and critical habitat elements for the listed and proposed species addressed in this biological and conference opinion.

Species	Listing Status Final Rule Publication Date	Critical Habitat	Biological Information, Historical Population Trends
Snake River sockeye salmon	November 20, 1991; 56 FR 58619	December 28, 1993; 58 FR 68543 (FINAL RULE)	Waples *et al.* 1991a; Burgner 1991
Snake River fall chinook salmon	April 22, 1992; 57 FR 34653	December 28, 1993; 58 FR 68543 (FINAL RULE)	Waples *et al.* 1991b; Healey 1991
Snake River spring/summer chinook salmon	April 22, 1992; 57 FR 34653	December 28, 1993; 58 FR 68543 (FINAL RULE)	Matthews and Waples 1991; Healey 1991
Upper Willamette River chinook salmon	March 24, 1999; 64 FR 14308	March 9, 1998; 63 FR 11482 (PROPOSED RULE)	Myers *et al.*1998; Healey 1991
Upper Columbia River spring run chinook salmon	March 24, 1999; 64 FR 14308	March 9, 1998; 63 FR 11482 (PROPOSED RULE)	Myers *et al.*1998; Healey 1991
Lower Columbia River chinook salmon	March 24, 1999; 64 FR 14308	March 9, 1998; 63 FR 11482 (PROPOSED RULE)	Myers *et al.*1998; Healey 1991
Snake River Basin steelhead	August 18, 1997; 62 FR 43937	February 5, 1999; 64 FR 5740 (PROPOSED RULE)	Busby *et al.* 1995; Busby *et al.* 1996
Upper Columbia River steelhead	August 18, 1997; 62 FR 43937	February 5, 1999; 64 FR 5740 (PROPOSED RULE)	Busby *et al.* 1995; Busby *et al.* 1996
Middle Columbia River steelhead	March 25, 1999; 64 FR 14517	February 5, 1999; 64 FR 5740 (PROPOSED RULE)	Busby *et al.* 1995; Busby *et al.* 1996
Upper Willamette River steelhead	March 25, 1999; 64 FR 14517	February 5, 1999; 64 FR 5740 (PROPOSED RULE)	Busby *et al.* 1995; Busby *et al.* 1996
Lower Columbia River steelhead	March 19, 1998; 63 FR 13347	February 5, 1999; 64 FR 5740 (PROPOSED RULE)	Busby *et al.* 1995; Busby *et al.* 1996
Columbia River chum salmon	March 25, 1999; 64 FR 14308	March 10, 1998; 63 FR 11774 (PROPOSED RULE)	Johnson *et al.*1997; Salo 1991
Southwestern WA/Columbia River coastal cutthroat trout	Proposed April 5, 1999; 64 FR 16397	N/A	Johnson *et al.*1999; Trotter 1989

IV. EVALUATING PROPOSED ACTIONS

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 C.F.R. Part 402 (the consultation regulations). NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify critical habitat. This analysis involves the initial steps of: (1) Defining the biological requirements and current status of the listed species and (2) evaluating the relevance of the environmental baseline to the species' current status.

NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the proposed action would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of listed species in the wild. In making this determination, NMFS must consider: (1) Collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. If NMFS finds that the action is likely to jeopardize the listed or proposed species, NMFS must identify reasonable and prudent alternatives for the proposed action.

Furthermore, NMFS evaluates whether the action is likely to destroy or adversely modify the listed species' critical habitat, directly or indirectly. The NMFS must determine whether habitat modifications appreciably diminish the value of critical habitat for survival and recovery of the listed species. The NMFS identifies the effects of the action that impair the function of any essential element of critical habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will adversely modify critical habitat, NMFS must identify any reasonable and prudent measures available.

For the proposed action, NMFS' jeopardy analysis considers direct or indirect mortality of fish attributable to the action. NMFS' critical habitat analysis considers the extent to which the proposed action impairs the function of essential elements necessary for adult and juvenile migration of the listed salmon under the existing environmental baseline.

A. Biological Requirements

The first step in the method NMFS uses for applying the ESA standards of section 7 (a)(2) to listed salmon is to define the species' biological requirements that are most relevant to the consultation. NMFS also considers the current status of the listed species, taking into account population size, trends, distribution and genetic diversity. To assess the current status of the listed species, NMFS starts with the determinations made in its consideration of whether to list the particular species for ESA protection and also considers new data available that is relevant to those determinations (see Table 2 for references).

In some cases, the listed species' biological requirements may be described in terms of population viability using such variables as a ratio of recruits to spawners, a survival rate for a given life stage (or set of life stages), a positive population trend, or a threshold population size. The listed species' biological requirements may also be described as the habitat conditions necessary to ensure the species' continued existence (*i.e.*, functional habitats) and these can be expressed in terms of physical, chemical, and biological parameters. However species' biological requirements are expressed—whether in terms of population variables or habitat components—there is a strong causal link between the two: actions that affect habitat have the potential to affect population abundance, productivity, and diversity.

However, it is often difficult to quantify the effects of a given habitat action in terms of its impact on biological requirements for individual salmon. Thus it follows that while it is often possible to draw an accurate picture of a species' range-wide status—and in fact doing so is a critical consideration in any jeopardy analysis—it is difficult to determine how that status may be affected by a given habitat-altering action. Given the current state of the science, usually the best that can be done is to determine the effects an action has on a given habitat component, and, since there is a direct relationship between habitat condition and population viability, extrapolate to the impacts on the species as a whole. Thus, by examining the effects a given action has on the habitat portion of a species' biological requirements, NMFS has a gauge of how that action will affect the population variables that constitute the rest of a species' biological requirements, and ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ecologically significant unit (ESU) levels, and effects on habitat would be readily quantifiable in terms of population impacts. In the absence of such information, NMFS' analysis must rely on generally applicable scientific research that can reasonably be extrapolated to the action area and to the populations in question. Therefore, in its habitat analysis, NMFS usually defines the biological requirements in terms of a concept called properly functioning condition (Attachment 1). Properly functioning condition (PFC) is the sustained presence of natural[3] habitat-forming processes that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features.

In the PFC framework, baseline environmental conditions may be described as "properly functioning," "at risk," or "not properly functioning." If a proposed action would be likely to

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[3] The word "natural" in this definition is not intended to imply "pristine," nor does the best available science lead us to believe that only pristine wilderness will support salmon. The best available science does lead us to believe that the level of habitat function necessary for the long-term survival of salmon (PFC) is most reliably and efficiently recovered and maintained by simply eliminating anthropogenic impairments, and does not usually require artificial restoration (Rhodes et al., 1994; National Research Council, 1996).

impair[4] properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat or both, depending upon the specific considerations of the analysis.

For this consultation, the biological requirements NMFS considers to be most relevant are: 1) Habitat characteristics in the lower Columbia River and estuary ecosystems that function to support successful migration, smoltification, and rearing; and 2) water quality that supports survival and recovery of listed species.

<u>Habitat Characteristics of the Lower Columbia River Ecosystem that Function to Support Successful Migration, Smoltification, and Rearing</u>

The Columbia River estuary plays a critical role in the survival and recovery of listed or proposed salmon, providing refuge, nutrients, and conditions in which juvenile salmon change physiologically from a fresh water to a saltwater organism. A number of factors contribute to these functions. The quality and diversity of estuary habitat influences the abundance and diversity of the salmon populations that pass through the estuary. The estuary's ability to support productive food chains and prey species depends on the presence of a variety of habitats. Estuaries are perhaps most recognized as a transition habitat for salmon in their migrations to and from seawater (Groot and Margolis, 1991). The Columbia River estuary extends the freshwater habitat of salmon and expands habitat available for rearing (Wissmar and Simenstad, 1998). The estuary serves as a conduit to the ocean, transporting fish from the river to the ocean, and provides critical adult holding, spawning, incubation, juvenile rearing habitat and migration corridors for listed adult fish. Estuary conditions have an important effect on salmon survival (Emmett and Schiewe, 1997; Matthews et al., 1992; Hinrichsen et al., 1997), and on the number of salmon that can be supported in the Columbia River system. Elements that need to be provided for salmon in the Columbia River estuary that constitute properly functioning condition include: 1) Refugia, 2) sufficient and appropriate habitat for the physiological transition to saltwater, and 3) habitat supporting the necessary food production and retention of organic matter.

Structural and biological features of estuarine habitats that provide refugia from predators and off-channel areas protected from strong tidal and river currents are important to salmon survival. Important features that can minimize effects of predators and strong flows include: Complex dendritic tidal channel systems and other landforms (islands, peninsulas, etc.); wood, emergent vegetation, or other structural components; and connections between mainstem channels and floodplains. Availability of refugia under variable tidal and river flow levels is necessary to

[4] In this document, to "impair" habitat means to reduce habitat condition to the extent that it does not fully support long-term salmon survival, and therefore "impaired habitat" is that which does not perform that full support function. Note that "impair" and "impaired" are not intended to signify any and all reduction in habitat condition.

support diverse rearing and migratory behaviors and thereby spread the physical and biological risks to salmon through time and space.

The position and extent of habitats that allow juvenile salmon gradually to adapt to saltwater are particularly important to their performance and survival. Availability of feeding habitats and refugia within the oligohaline or brackish zones of the estuary constitute a critical transition area for smaller salmon juveniles when they first enter saline waters. The proper function of habitats in this area and their linkage to adjacent habitats require that salmon can move freely upstream and downstream as needed to adjust their distribution with changes in the salinity gradient.

Persistence and resilience of Pacific salmon are linked to the quantity and quality of habitats throughout the range of their life history, from freshwater spawning to oceanic rearing environments. But salmonid ecosystems are not static; freshwater, estuarine and ocean conditions vary over many time scales, but seldom in synchrony. To compensate for such uncertainty, salmon have evolved a diversity of life-history traits that allows them to function in a variable environment. Among these are traits associated with the use of estuarine habitats. For example, salmon populations within and among species enter the Columbia River estuary at different times, reside for varying periods, and select different habitats in time and space. This variety of rearing strategies minimizes the risk of brood failure, since not all individuals behave identically under the same set of environmental conditions. Slightly different patterns of migration and rearing in the estuary are advantageous in different years depending, for example, on the timing of flood events, the onset of the spring transition, the distribution of coastal upwelling, the timing of prey production, and the distribution of predators. Thus, diversity of life-history patterns within and among populations affords resilience to salmon species in a changing environment. The quality and diversity of estuarine rearing habitats are important factors influencing the diversity of salmon life-history types that enter a variable ocean environment.

Continued survival of juvenile salmon in the ocean is often dependent on prior growth in the estuary, which is largely supported by detrital food chains and prey species from a variety of estuarine habitats. Important rearing habitats for juvenile salmon include those that produce, retain, and concentrate macrodetritus in the high-flow environment of the Columbia River estuary. Among areas of production and accumulation of organic matter are dendritic tidal channels and backwater sloughs, estuarine and tidal-freshwater marshes and swamps, vegetated riparian habitats, mud and sandflats of shallow peripheral bays, and the microdetrital producing estuarine turbidity maximum zone in the mainstem channels.

Tidal channels and backwater sloughs, estuarine and tidal-freshwater marshes and swamps, vegetated riparian habitats and other areas are important. In particular, a food web (called a "macrodetrital food web") based on larger organic material from marsh vegetation and small organisms called *Corophium* contribute directly to salmonid productivity. The current system has less of this macrodetrital capacity than it did historically, and is more dependent on a "microdetrital" food web supported by what is called the Estuarine Turbidity Maximum zone in the mainstem channels. Macrodetrital webs are supported by tidal channels and backwater sloughs, marshes and swamps, vegetated riparian habitats, and other shallow water and low velocity habitats.

Fish and invertebrate community surveys in the Columbia River estuary provide strong evidence that physical processes that concentrate organic matter and maintain zooplankton populations in the estuary control the feeding environment for estuarine fishes (Bottom and Jones, 1990). In particular, a food web based on macrodetritus derived from emergent marsh vegetation and infauna (e.g., *Corophium*) is more likely to directly support salmonid productivity than one based on micro-detritus (Bottom et al., 1984; Salo, 1991). Macrodetritus food webs are associated with shallow water estuarine habitat (Bottom and Jones, 1990; Dawley et al., 1986). Shallow water habitats also provide refuge and feeding areas for migratory fish.

Another important component of the estuarine food web in the Lower Columbia River estuary is what is called the estuarine turbidity maximum (ETM). The ETM results from the combination of two processes, strong tidal forces and its interaction with the salt wedge in the Lower Columbia River. This combination results in elevated levels of suspended particulate matter. The physical process occurs when strong tidal forces push salinity upriver beneath the outflowing river water. The turbulence caused by this tidal forcing results in resuspension of sediment and other particulate material present on the river bed. Concurrently, dissolved material in the river water flocculates when it comes into contact with the salt wedge pushing its way up river. The interaction of these forces results in the ETM. The ETM supports the detrital food chain and salmon production, and in the current estuary the ETM sustains the highest secondary productivity (Simenstad et al. 1990). Fish and invertebrate community surveys in the Columbia River estuary provide strong evidence that physical processes that promote concentration of organic matter and the maintenance of zooplankton populations within the estuary control the feeding environment for estuarine fishes (Bottom and Jones, 1990). With the degradation of the macrodetrital food chain, the ETM has assumed an important role in providing food for salmon that enables them to mature properly and enhances their ability to survive.

Loss of macrodetrital production from loss of emergent marsh vegetation, coupled with the effects of water entrainment by dams has enhanced the production of a microdetrital food web, accentuated through the ETM. The enhanced microdetrital food web has essentially replaced the macrodetrital/*Corophium* based food web in the lower river/estuarine system, thereby making the ETM the major secondary producer in the estuarine system, probably to a greater extent than was the case historically. The secondary producers the ETM system supports are not as productive as the important *Corphium*-based food web.

<u>Water Quality that Supports Survival and Recovery of Listed Species</u>

Water temperature, turbidity, dissolved gases (e.g., nitrogen and oxygen), nutrients, heavy metals, inorganic and organic chemicals, and pH all influence water quality and the ability of surface waters to sustain fish populations (Spence et al., 1996). Specific water quality requirements important to listed salmonids include temperature ranges from 7.2 - 15.6 ^{o}C (EPA et al., 1971), dissolved oxygen normally saturated levels greater than 7mg/l (Reiser and Bjorn, 1979), nitrate-nitrogen ranges from 0.02-0.03 mg/l, and turbidity ranges from 10-25 nephelometric units (NTUs) (Lloyd, 1987). Also critical for different life stages are diversity in river velocities, which range from 15-100 cm/s, and diversity in substrate size and river depth (Groot and Margolis, 1991).

In the context of this consultation, turbidity is the water quality parameter of concern. Although very high concentrations of suspended sediment are required to cause direct mortality of juvenile salmon, non-lethal effects occur at relatively low levels. These non-lethal effects can have the effect of reducing fish fitness and contribute to elevated mortality later in the life of the fish. Juvenile coho salmon actively avoid turbidities over 70 NTUs when areas of clearer water are available (Bisson and Bilby, 1982). Increased turbidity as a result of suspended sediments can cause a number of negative environmental conditions for fish including:

- Reduced light penetration, which in turn affects the reactive distance of juvenile and adult salmonids for food capture;
- avoidance of areas by salmon and trout with high percentages of sand, silt, and clay (Burner, 1951; Stuart, 1953);
- increased straying rates of adult salmon;
- force juvenile salmon from preferred habitats; and
- impair feeding by juvenile salmon, thereby reducing growth, and increase the mortality of eggs and fry.

B. Environmental Baseline

The current status of the listed species in the project area, and their risk of extinction, have not significantly changed since the species were listed. The NMFS is not aware of any new data that would indicate otherwise. The environmental baseline, to which the effects of the proposed action are added, “include the past and present impacts of all Federal, State or private activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation process” (50 CFR section 402.02). The biological requirements of the listed species are currently not being met under the environmental baseline. The species status is such that there needs to be significant improvement in the current environmental baseline conditions, including the condition of any designated critical habitat. A substantial proportion of the shallow water habitats that support migration, smoltification, and rearing have been lost or degraded by shoreland development, diking, dredging, and filling activities. A primary goal of habitat recovery in the Columbia River estuary should be to increase the survival and recovery of salmon by restoring the spatial and temporal diversity and connectivity of habitats available that provide these biological requirements.

To a significant degree, the risk of extinction for salmon stocks in the Columbia River basin has increased because complex freshwater and estuarine habitats needed to maintain diverse wild populations and life histories have been lost and fragmented. Estuarine habitat has been lost or altered directly through dredging, filling, and diking. It has also been removed indirectly through the effects of dredging and flow regulation on sediment transport and on the salinity ranges of specific habitats within the estuary. Not only have rearing habitats been removed, but the connections among habitats needed to support tidal and seasonal movements of juvenile salmon have been severed. One example is the diking and filling of floodplains formerly connected to the tidal river, which have removed large expanses of low-energy, off-channel habitat for salmon rearing and migrating during high flows. Similarly, diking of estuarine marshes and forested wetlands within the estuary has removed 65% to 75% of these important off-channel habitats. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. The total volume of the estuary inside the entrance has declined by about 12% since 1868. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production. Sherwood et al. (1990) also analyzed early navigational charts and noted profound changes in the river entrance from year to year. The pre-development river mouth was characterized by shifting shoals, sandbars, and channels forming ebb and flood tide deltas. Prior to dredging and maintenance, the navigable channel over the tidal delta varied from a single, relatively deep channel in some years to two or more shallow channels in other years.

Flow regulation, water withdrawal and climate change have reduced the Columbia River's average flow and altered the seasonality of Columbia River flows, sediment discharge and turbidity, which have changed the estuarine ecosystem (National Research Council, 1996; Sherwood et al., 1990; Simenstad et al., 1990, 1992, Weitkamp, 1994). Annual spring freshet flows through the Columbia River estuary are approximately one-half of the traditional levels that flushed the estuary and carried smolts to sea, and total sediment discharge is approximately one-third of 19th Century levels. Decreased spring flows and sediment discharges have also reduced the extent, speed of movement, thickness, and turbidity of the plume that extended far out and south into the Pacific Ocean during the spring and summer (Cudaback and Jay, 1996, Hickey et al., 1997). Changes in estuarine bathymetry and flow have altered the extent and pattern of salinity intrusion into the river and have increased stratification and reduced mixing (Sherwood et al., 1990).

Development has changed the circulation pattern in the estuary and increased shoaling rates. Sediment input to the estuary has declined due to the altered hydrograph and the estuary is now a more effective sediment trap (Northwest Power Planning Council, 1996). Although the Columbia River is characterized as a highly energetic system, it has been changing as a result of development and is now similar to more developed and less energetic estuaries throughout the world (Sherwood, et al., 1990).

Based on these factors, NMFS finds that habitat characteristics of the Lower Columbia River ecosystem are not properly functioning relative to the identified biological requirements and essential critical habitat elements.

V. ANALYSIS OF EFFECTS

A. Effects of Proposed Action

The NMFS analyzes the effects of the proposed action to include all the research and restoration to which the Corps is committing under all of its authorities.

Channel deepening and disposal of the dredged material speed up the natural processes of sediment erosion, transportation and deposition (Morton, 1977). Briefly summarized, the physical effects to river systems from channel deepening and disposal include: Increases in turbidity during dredging, changes in bottom topography with resultant changes in water circulation, and changes in the mechanical properties of the sediment at the dredge and disposal sites (Morton, 1977). The significance of the physical effect is a function of the ratio of the size of the dredged area to the size of the bottom area and water volume (Morton, 1977).

Based on the potential physical effects to the Lower Columbia River ecosystem from channel deepening and disposal, NMFS believes that the following effects potentially resulting from the proposed action could adversely affect listed species:

- Interaction of channel deepening with potential changes in flow regimes;
- potential reduction of suitable estuarine habitat;
- changes to the estuarine food web;
- changes to salinity intrusion;
- potential entrainment of juvenile fish;
- behavioral and sub-lethal affects from exposure to increased turbidity;
- potential redistribution of toxic contaminants;
- juvenile stranding and modifications to nearshore habitat from vessel wakes; and
- interrelated and interdependent effects of increased industrialization at port facilities.

Interaction of Channel Deepening with Potential Changes in Flow Regimes

The interaction of a deepened channel in concert with likely flow scenarios may reduce the estuary’s ability to function as a conduit to the ocean environment by the altered flow characteristics. However, these effects are uncertain with respect to salmon migration and survival and require research to verify. The Corps proposes to study these effects, assess their impact on estuarine conditions with which NMFS is most concerned – salinity and the manner in which juvenile salmon use estuarine habitats – and address any adverse effects of this interaction through short- and long-term restoration of shallow water and low velocity habitat. While the interactive effects of channel deepening and flow regulation may adversely affect listed species in the estuary, NMFS anticipates that the proposed habitat restoration measures should offset any adverse effects that may be identified through the proposed research and monitoring program.

Potential Reduction of Suitable Estuarine Habitat

Channel deepening has the potential to reduce the availability of suitable salmon habitat. Low velocity, shallow water habitats appear to be especially important to salmon (Bottom and Jones 1990, Dawley et al., 1986), providing areas for refuge and feeding. Channel deepening has been shown in some instances to reduce the availability of shallow water, low velocity habitat (Sherwood et al., 1990). The proposed action includes research and monitoring and evaluation measures to study these potential effects, and address any identified impacts by short- and long-term restoration of shallow water and low velocity habitat. These measures should move the estuary toward properly functioning conditions. The NMFS concludes that this proposal is likely to offset any reduction in existing habitat that may result from channel deepening.

Changes to the Estuarine Food Web

Simenstad et al. (1990, 1992) emphasize the joint role that flow regulation, navigational development and diking have played in changing the estuarine ecosystem from one dominated by marsh productivity and infauna (e.g., *Corophium*) to one based more on re-processing of fluvial micro-detritus by the ETM. Macrodetritus derived from emergent marsh vegetation has undergone a dramatic reduction due to the loss of shallow water habitat. The loss of those production areas reduced emergent plant production by 82% (Sherwood et al., 1990). Sherwood et al. (1990) estimate that, before extensive development, the standing crop of organisms that feed on the macrodetritus would have been 12 times the current standing crop. A food web based on *Corophium* is more likely to directly support salmonid productivity than the microdetrital-based ETM system.

Increasing the mean depth of the channel could increase the residence time of near-bottom waters and suspended particulate matter in the estuary. The largest residence times of near-bottom waters in the main body of the estuary are associated with the ETM, maintained in part by upstream bottom flow. Changes in the salinity distribution could also change locations, surface areas and volumes of key low-salinity habitats used by salmonids. These habitats support the ETM ecosystem in which is found the food web responsible for the bulk of secondary productivity in the estuary. If key habitat volumes are reduced or moved, then decreases in secondary productivity may occur. Thus, by altering the location of the ETM through channel deepening, the proposed action could alter a key process that supports estuarine food chains.

The proposed action would address these potential effects by short- and long-term ecological restoration that expands available shallow water and low velocity habitats, and moves the estuary toward a *Corophium*-based food web. Given the current imbalance in the estuarine food web, focusing restoration on shallow water habitats that support *Corophium* and related prey organisms will be more effective in establishing properly functioning conditions than would efforts to address ETM effects *per se.* In summary, the proposed action may cause changes to the estuarine food web, but the proposed conservation measures should address these effects appropriately.

Potential Changes to Salinity Intrusion

Channel deepening has the potential to change the locations, surface areas and volumes of key low salinity habitats used extensively by salmonids and the ETM zone (USACE, 1999). Such changes are dependent upon local flows and existing bathemetry. The extent and distribution of salinity intrusion within the estuary varies with tide stages and freshwater flow conditions. Salt water moves into the estuary during the flood tide and mixes with the freshwater inflow from upstream. Because salt water has a higher density than freshwater, the salinity concentrations tend to be higher at the bottom than at the surface. This results in the formation of a salt wedge, with higher salinity concentrations in the navigation channel than in the adjacent shallow areas. The salinity regime affects the distribution and abundance of estuarine organisms, especially low salinity habitats.

Removal of or changing critical low salinity habitats by the proposed action may alter the existing micro-detrital secondary ETM productivity crucial to salmonids within the lower Columbia River ecosystem and estuary in the absence of the *Corophium*-based macrodetrital food web associated with shallow water estuarine systems.

Small changes in salinity distribution may have significant effects on the ecology of fishes, including salmonids. Salinity distribution, as affected by tidal flow and river discharge, is a primary factor explaining seasonal species distributions and the structure of entire assemblages of fish and epibenthic and benthic invertebrate prey species throughout the Columbia River estuary (Haertel and Osterberg, 1967; Bottom and Jones, 1990; Jones et al., 1990). By altering the distribution of preferred habitats within particular salinity ranges and the particular suite of species that salmon encounter at different locations during their estuarine residence, small changes in salinity structure may have consequences for estuarine food webs and fish production in the estuary. In particular, small changes in the distribution and gradient of oligohaline salinities could change the type of habitats available when juvenile salmon must make the critical physiological transition from riverine to brackish salinities. Assessments of the ecological effects of salinity change on estuarine fishes, rearing conditions at specific places and times that support at-risk populations are needed; additional modeling analysis of salinity intrusion and changes in estuarine currents would improve our ability to understand the effects of channel deepening.

The Corps' salinity intrusion studies have shown that the increased salinity intrusion from a three foot deepening would be small and would have no significant impact on estuary habitat. These conclusions are based on the results of hydraulic modeling of salinity intrusion. As with any modeling of complex ecosystems, there is a degree of uncertainty in the results. This uncertainty comes from two main sources, our limited knowledge of the estuary ecosystem, and the inability to model all possible conditions that could alter salinity intrusion. For example, in the summer and fall seasons, estuarine salinity intrusion in the Columbia River estuary undergoes monthly neap-spring transitions between highly stratified and weakly stratified or partially mixed states (Jay and Smith, 1990 a,b,c). Any changes in salinity intrusion related to channel deepening may occur at times when the deeper channel perpetuates a highly stratified state to a lower flow level or higher tidal range than would be the case without a deeper channel. Model runs calibrated over the range of plausible flows (~65 kcfs to ~1,000 kcfs) would help understand where and when large differences are predicted. Although NMFS believes that the proposed three foot deepening has the potential to negatively affect listed species and associated critical habitat, at this time NMFS cannot quantify the level of potential impact(s).

These effects are similar to those discussed in connection with changes to the food web – they may alter the existing micro-detrital secondary ETM productivity. The proposed action would address these effects by short- and long-term ecological restoration that expands available shallow water and low velocity habitat, and moves the estuary toward a *Corophium*-based food web. As discussed above, given the current imbalance in the estuarine food web, focusing restoration on habitats that support the *Corophium*-based food web is appropriate.

The proposed action also calls for the development of a monitoring program to evaluate physical and ecological changes from channel deepening, and the effectiveness of fish protection and habitat restoration. In developing this program, the Corps is committed to explore the need for further salinity intrusion modeling.

<u>Potential Entrainment of Juvenile Fish</u>

Hydraulic suction dredging has the potential to entrain juvenile salmonids. When juvenile salmonids come within the “zone of influence” of the cutter head, they may be drawn into the suction pipe (Dutta 1976, Dutta and Sookachoff; 1975a). However, studies of entrainment have not produced consistent results. Braun (1974), in testing mortality of entrained salmonids, found that 98.8% of entrained juveniles were killed. McGraw and Armstrong’s (1990) examination of fish entrainment rates from dredging activities outside peak migration times in Grays Harbor from 1978 to 1989 resulted in only one juvenile salmon being entrained. Stickney (1973) found no evidence of fish mortality while monitoring dredging activities along the Atlantic Intracoastal Waterway. Dutta (1976), however, reported that salmon fry were entrained by suction dredging in the Fraser River and that suction dredging during juvenile migration should be controlled. Dutta and Sookachoff (1975b) indicate that suction dredging operations “cause a partial destruction of the anadromous salmon fishery resource of the Fraser River.” Boyd (1975) indicated that suction pipeline dredges operating in the Fraser River during fry migration took substantial numbers of juveniles. As a result of these studies, the Canadian government issued dredging guidelines for the Fraser River to minimize the potential for entrainment (Boyd 1975). Further testing in 1980 by Arseneault (1981) resulted in entrainment of chum and pink salmon but in low numbers relative to the total of salmonids outmigrating (.0001 to .0099%). The

Portland District Corps of Engineers sampled dredge entrainment of salmon within the Columbia River in 1985-88 (Larson and Moehl, 1990) and again in 1997 and 1998. In the 1985-88 study, no juvenile salmon were entrained, and the 1997-98 study resulted in no fish entrained during normal dredging operations (R2 Research Consultants, 1999).

While the Corps data show no direct effect from entrainment, there is the potential for indirect effects from the dredging activity. Changes in behavior or displacement away from an animal's preferred habitat could result in a change in their migratory behavior, timing of ocean entry, exposure to predators, and potentially, survival. Further biological monitoring of entrainment would be necessary to further quantify entrainment impacts.

The proposed action proposes to address these concerns by placing the discharge pipe deeper than 20 feet during flow lane disposal, operating hydraulic dredges with the intake at or below the surface of the material being removed, except for brief periods, and monitoring the physical effects of the project during its construction phase. Prior studies in connection with maintenance dredging have shown that listed species use areas higher in the river channel, or shallow water habitat. Thus, the protective measures proposed by the Corps should ensure that dredging will not be in areas that are used by listed species are adequate to address any direct and indirect effects.

Behavioral and Sub-lethal Effects from Exposure to Increased Turbidity

NMFS expects the turbidity generated from the dredging process to be limited in spatial scope and confined to the area close to the draghead as a result of the coarseness of the sand being dredged. Issues involving turbidity associated with flowlane disposal were addressed in the 1993 Biological Opinion. In that opinion, NMFS concluded that mortality resulting from turbidity was not an issue of concern. We find no reason to change that conclusion in this opinion, although there may be impacts associated with sublethal effects, e.g., feeding and health of juveniles.

Increased suspended sediment loads, especially when those sediments include sand-sized particles, can increase the amount of fine sediment in spawning gravel used by salmon. Egg mortality increases rapidly as fine sediment abundance in gravel increases. Evaluation of numerous studies by Bjornn and Reiser (1991) indicated that egg survival rates declined from over 80% when fine sediment levels were 10% or less to 50% survival at fine sediment levels of 20%. Particle size definition of fine sediment varied in these studies from < 2mm to <6.4mm and proportion of fine sediment was calculated both as % weight or % volume. Thus, even relatively minor contributions of fine sediment can dramatically influence egg survival. The extent to which elevated suspended sediment levels from dredging will impact egg to fry survival depends on the location of key spawning areas, the current level of fine sediment in the gravel and the likelihood that sediment generated by the dredging will deposit at these locations while the eggs are incubating. While the Corps has determined that there is a very small volume of fine grained material that will be resuspended, this material could affect spawning that may occur in the estuary. The extent of spawning by salmon in the lower Columbia River is not well known, and therefore, the NMFS has adopted as a term and condition in the incidental take statement a requirement that the Corps analyze potential impacts of increased sedimentation to spawning areas in the estuary (see Paragraph 5.a., p. 41). Chum salmon do spawn at the confluence with the Grays River and likely utilize gravel deposits at the mouths of other tributaries to the lower river.

Potential Redistribution of Toxic Contaminants

Sediment sampling results from the Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement indicate that the material to be dredged from the mainstem Columbia River navigation channel is not contaminated and is suitable for non-confined in-water and upland disposal. The material to be dredged consists primarily of poorly sorted sand with few fine sediments, except for the turning basin at Astoria, Oregon. The organic content within the proposed dredging prism is also low, except for the turning basin. Dredging operations in the Columbia River will likely result in resuspension and redistribution of bottom sediments in the dredge area, as demonstrated in many dredge operations (Morton, 1977; Hershman, 1999). There is a potential for redistribution of fine grained material from upriver contamination (Willamette River) to shallow water, low flow sites represents in the lower river. This poses the potential that juvenile salmon that use these shallow water, low flow habitats will ingest prey in which toxic material has accumulated.

Recent investigations of salmon prey (McCain, 1999) suggest that this potential problem may be more significant that is suggested by bulk sediment contaminant data. Prey feed selectively on organic-rich particles that can be present at low levels in Columbia River sediments. This selective feeding can result in elevated levels of contaminants in prey that would not be expected from bulk sediment contaminant data. Aquatic prey organisms in depositional zones may accumulate contaminants redistributed to sediments along with particulate matter, leading to greater uptake and bioaccumulation of contaminants in predators (Zuranko et al., 1997).

The proposed action addresses the potential redistribution of toxic contaminants by the Corps' ongoing commitment to participate in developing freshwater sediment quality guidelines (screening levels) with acute, chronic, and bioaccumulative endpoints. Before any operation begins, dredge material is evaluated in accordance to the Dredged Material Evaluation Framework manual. If the initial screening value is exceeded, the Corps performs biological effect-based testing for acute, chronic, and bioaccumulation in accordance with the above mentioned manual. If the dredge material does not meet the biological testing criteria, the Corps will utilize a confined disposal site (personal communication with Mark Siipola, COE).

The Corps is currently working with NMFS and other Federal and state agencies to further refine the bulk sediment screening levels to better reflect the potential for bioaccumulation. Under the proposed action, the Corps will work NMFS and others regarding adoption of these screening levels into the Dredged Material Evaluation Framework for the Lower Columbia River

Management Area regarding unconfined aquatic disposal. The in-water disposal of dredged material will be re-assessed as the Dredged Material Evaluation Framework is updated.

Juvenile Stranding as a Result of Vessel Wakes

Stranding of juveniles by ship wakes has been identified as a significant cause of juvenile mortality in the Lower Columbia River by the Washington Department of Fish and Wildlife (Hinton and Emmett, 1994). Hinton and Emmett (1994), citing research conducted in 1974 and 1975 by K. Baursfeld of the Washington Department of Fisheries, state that stranding rates were as high as 117 fish per vessel passage. They also cite observations of high numbers of strandings at Jones Beach by NMFS staff after vessel passage in 1977 and 1984. Strandings of significant numbers of juveniles on beaches near Longview, Washington were observed in March, 1999 (Colbert, 1999). Observations in 1992 and 1993 by NMFS (Hinton and Emmett, 1994) on stranding indicated that there were many parameters such as vessel speed and shape; distance of vessel from beach; tide stage; beach slope; salmon abundance and condition; and river flow conditions that lead to stranding by juveniles. Although they indicated that stranding was not presently a significant cause of juvenile salmonid mortality, Hinton and Emmett (1994) reiterated the Washington Department of Fisheries recommendation that measures be implemented to reduce the potential for stranding.

Ship wake erosion is becoming a major problem in the Columbia River downstream of Portland and Vancouver. Housing next to the river has increased. Requests for modifications to shorelines through beach nourishment or rip-rap placement to protect property from erosion caused by ship wakes has also subsequently increased. These modifications can increase potential predation and decrease benthic invertebrate populations. Facilitation of vessel transit through channel maintenance adds to this problem. Vessel speed limits could reduce the potential for erosion resulting from ship wakes.

The Corps proposes to work with NMFS, the U.S. Coast Guard, and the river pilots to develop vessel speed limits that would reduce the potential for stranding of juvenile salmon from ship wakes and exacerbate riverbank erosion. While the impact of vessel wakes on salmonids is difficult to predict, NMFS anticipates that these effects would be relatively minor, and the proposed action appropriately accounts for them.

Interrelated and interdependent effects of increased industrialization at port facilities

The channel deepening project is likely to lead indirectly to increased industrialization, especially related to expansion of port facilities. Facilitation of vessel transit has led, and continues to lead, to expansion of port facilities all along the Columbia River, as evidenced by the Port of Portland's proposed West Hayden Island Project, the Port of Vancouver's proposed Gateway Development Project, and the Port of St. Helen's proposed expansion at Rainier, Oregon. This results in increased dredging around dock facilities, alteration and loss of riparian areas, increased pollution, alteration and loss of shallow water habitat, and, potential additional dredging for deeper access channels to enable ports to compete with other west coast port facilities. While these factors are difficult to quantify, the long-term restoration program proposed by the Corps should appropriately address these potential effects.

Summary of Effects

NMFS expects the proposed action will have an incremental adverse effect on an estuarine system that has been grossly altered by previous dredging, disposal of dredged material, diking and filling, sewage and industrial discharges, water withdrawal, flow regulation and other activities. It is difficult to say with any certainty whether this action will degrade the estuarine ecosystem beyond a critical threshold. The most predictable impacts from the proposed action are changes in the physical dynamics of the estuary. Specifically, these impacts include changes in estuarine circulation patterns, changes in location and timing of sea water intrusion, altered rates and locations of sedimentation, and changes in the turbidity maximum. Such changes will have biological ramifications. Translation of such physical changes into specific biological impacts, however, is problematic. The magnitude of these changes to the listed salmon species cannot be predicted with certainty. We know biological effects will occur, but cannot quantify those effects on salmon or their prey. The research, ecological restoration, protective and monitoring measures proposed by the Corps are appropriately designed to address these potential effects.

B. Critical Habitat

Five critical habitat elements may be affected by this action: riparian vegetation, water quality, substrate, food and safe passage. The Corps has avoided placement of dredge spoils in upland areas that are currently providing riparian vegetation. As mentioned above, water quality will be adversely affected by a slight increase in turbidity. The lack of fine-grained material in the channel decreases the potential for toxics to be resuspended as part of the dredging process. The substrate in disposal areas and the channel are generally uniform in size and are not likely to be significantly altered as a result of dredging or disposal. Benthic invertebrate populations are of low densities within the navigation channel and of limited value to salmonids. Dredging will temporarily decrease densities of invertebrates, but recolonization of newly deposited substrates to pre-dredging levels has been shown to occur relatively quickly. As mentioned above, entrainment is not an issue of safe passage.

C. Cumulative Effects

Cumulative effects are defined in 50 CFR part 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." The proposed action under consideration encompasses the Columbia River from the mouth to the Interstate 5 Bridge at the City of Portland. This area is currently a disturbed estuarine ecosystem altered by previous dredging to establish the navigation channel, disposal of dredged material, diking and filling, sewage and industrial discharges, water withdrawal, and flow regulation, to highlight a few of the anthropogenic activities that have occurred over the last 100 years. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes and are not considered cumulative effects.

As noted above, the channel deepening project is likely to lead indirectly to increased industrialization, especially with regard to expansion of port facilities. Such increased industrialization has the potential to result in additional dredging around dock facilities, alteration and loss of riparian areas, increased pollution, alteration and loss of shallow water habitat, and, potential additional dredging for deeper access channels to enable ports to compete with other west coast port facilities. These developments will be reviewed through section 7 consultation processes.

VI. CONCLUSION

In determining whether the restoration, research, monitoring and other aspects of the proposed action sufficiently address the action's potential adverse effects to avoid jeopardy, NMFS has relied on the best available scientific and commercial data. In making this judgment, NMFS has also considered mitigation assessment methodologies that have been used in evaluating remediation for environmental loss. The methodologies NMFS sometimes uses to assess remediation of damage to wetlands and other aquatic resources (e. g., the sequence defined in Council on Environmental Quality mitigation regulations, 40 CFR 1508.20, or the memorandum of agreement between the Environmental Protection Agency and the Department of the Army concerning mitigation under section 404 of the Clean Water Act) generally suggest that mitigation should be based on the values and functions of the aquatic resource that will be impacted, and that the mitigation should assure no net loss of values with a margin of safety to reflect risk regarding the success of the mitigation plan. In effect, this objective is met when the values supplied by the restored habitat match or exceed habitat values before they were disturbed by the proposed action.

Where the extent of the loss is known, the adequacy of mitigation can be evaluated by methods ranging from professional judgment-based compensation ratios that specify acres of compensation required to replace acres lost, to relatively sophisticated models that use a quantitative measure of habitat functions and equivalencies. One such method is Habitat Equivalency Analysis, a method NMFS uses to determine compensation in natural resource injury cases under the Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) and the Oil Pollution Act. Habitat Equivalency Analysis can determine compensation in terms of fish and wildlife, their habitats or certain environmental services. For example, the Blackbird Mine natural resource damage assessment expressed the resource loss in terms of lost chinook salmon production, and the compensatory action in terms of restored or created habitat that, over time, was expected to produce the number of fish equivalent to those lost from mine contamination. All such determinations involve "scaling," where a judgment is made that the functional value of the compensatory action equals the functional value lost due to the injury involved. The basic components of the analysis are reasonable, quantitative estimates of the magnitude of loss and the potential benefit of the proposed mitigation.

In the case of channel deepening, we lack the first element in Habitat Equivalency Analysis and other mitigation models: a reasonable estimate of the loss. The most predictable impacts from the proposed action are physical changes in the dynamics of the estuary – changes in circulation patterns, sea water intrusion, sedimentation, and in the turbidity maximum. While we anticipate that such changes would have biological ramifications, we are uncertain whether and how these changes would affect salmon in general, or any of the listed stocks.

Without such an estimate of loss, the NMFS has relied on the professional opinions of scientists with expertise in estuarine ecology, to evaluate whether the restoration measures match or exceed the loss posed by the proposed action, in order to inform NMFS' judgment whether the proposed action would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of listed species in the wild. In NMFS's judgment, the research, monitoring, ecological restoration and physical protections included in the proposed action are likely to exceed habitat values that may be lost due to channel deepening, with an adequate margin of safety. Thus, NMFS concludes that the proposed action is unlikely to jeopardize the continued existence of Snake River sockeye salmon, Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River Basin steelhead, Upper Columbia River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Middle Columbia River steelhead, Columbia River chum salmon, Lower Columbia River chinook salmon, Upper Willamette River chinook salmon, Upper Columbia River spring run chinook salmon and Southwestern WA/Columbia River coastal cutthroat trout. While we conclude that there is the possibility of adversely modifying critical and proposed essential fish habitat (EFH) associated with these species, we also conclude that the proposed action (including research and restoration measures) will not appreciably diminish the value of critical habitat for the survival and recovery of listed species.

VII. CONSERVATION RECOMMENDATIONS

Endangered Species Act: Section 7 (a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the COE:

A. The Corps should coordinate research, analysis, monitoring, evaluation and ecological mitigation with:

1. Natural resource agencies, the Lower Columbia River Estuary Program, the Columbia River Estuary Study Taskforce, Tribes, and the public; and

2. the Corps' study of ways to alter flood control rule curves to address flow problems, especially the extent to which restoring shallow water estuary habitat may mitigate any additional flood risk stemming from altered rule curves.

To keep NMFS informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitat, NMFS requests that the Corps notify NMFS when any conservation recommendation is implemented.

Magnuson-Stevens Act: Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in federal fishery management plans and to require federal agencies to consult with NMFS on activities that may adversely affect EFH. The consultation requirements of section 305(b) of the Magnuson-Stevens Act (16 U.S.C. 1855(b)) provide that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;

- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH;

- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations.

The Columbia River estuary and the Pacific Ocean off the mouth of the Columbia River are designated as EFH for ground fish and coastal pelagic species (PFMC 1998a and 1998b). The channel deepening project would affect EFH for ground fish and coastal pelagic EFH by altering channel habitat through dredging and disposal. Dredging would affect EFH in the following ways: change bottom topography, remove benthic fish and prey populations and create a temporary increase in turbidity. Disposal in the flow lanes would change the topography of the bottom, cover existing benthic populations and temporarily increase turbidity in the water column. These effects on habitat are likely to affect populations of managed species by reducing food sources by reduction in benthic invertebrate species and reducing feeding success.

Conservation measures are discretionary measures suggested to minimize or avoid adverse modification of EFH, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the Corps:

B. The Corps should implement the mitigation package suggested by the COE in the November 1999 EFH Assessment submitted to NMFS, which includes the following measures:

   1. Perform dredging operations only in deep water areas that have low biological productivity;

   2. schedule dredging during construction to the extent possible to avoid impacting selected ground fish populations;

   3. test sediments and determine suitability for inwater disposal;

   4. utilize hydraulic dredges to reduce turbidity levels in the water column;

   5. reduce shallow water disposal by increasing upland disposal;

   6. utilize a 300-foot set back from the river bank to minimize damage to riparian areas associated with the new upland disposal sites;

   7. study deep water disposal sites in the river to determine fish use and habitat value, and use this information to manage the sites to further reduce impacts; and

   8. implement the ecosystem restoration projects proposed in the final EIS, providing additional EFH for the affected managed ground fish species;

C. In coordination with NMFS, the Corps should develop and implement an EFH monitoring program to determine the effects of the proposed action on groundfish, coastal pelagic, and proposed salmon EFH.

D. In coordination with NMFS, natural resource agencies, the Lower Columbia River Estuary Program, affected Tribes, and public, the Corps should:

   1. Within one year of the signing of the Record of Decision for the proposed project, identify and prioritize areas where shallow water habitat, low velocity wetlands, and other productive estuarine habitat could be created or restored; and, develop a plan to identify an appropriate mechanism to effect the identified restoration implementation.

2. Within five years of the signing of the Record of Decision, implement, according to the mechanism identified in the above restoration plan, activities to restore shallow water habitat, macrodetrital food webs and other properly functioning ecological conditions in the Columbia River estuary to reduce potential impacts to estuarine processes in essential fish habitat in the Lower Columbia River Estuary.

3. As part of the Corps' ecosystem restoration mission and responsibility under separate authority, independent of the Channel Improvement Project, expedite attainment of the objectives of the Lower Columbia River Estuary Program by restoring 1,500 acres of tidal wetlands by 2005, and 3000 acres between 2005 and 2010, subject to congressional authority and appropriation.

4. Collaborate with NMFS to an expedited re-establishment of 750 acres of tidal wetlands or other habitat that would contribute to macroditrital production.

VIII. REINITIATION OF CONSULTATION

Consultation must be reinitiated as follows:

- Before the end of the deepening project, and prior to initiation of maintenance dredging of the deepened channel;
- every three years thereafter;
- if the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded;
- if new information reveals effects of the action may affect listed species in a way not previously considered;
- if the action is modified in a way that causes an effect on listed species that was not previously considered; or
- if a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

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X. INCIDENTAL TAKE STATEMENT

Sections 4 (d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patters such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary; they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The COE has a continuing duty to regulate the activity covered in this incidental take statement. If the COE (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

Should Southwest Washington/Columbia River cutthroat trout be listed under the ESA, the NMFS expects that this Biological Opinion will be the basis of a biological opinion for this pecies[5]. Further, the following Incidental Take Statement is expected to become effective following the NMFS' adoption of this Conference Opinion as a biological opinion if the listing of cutthroat trout becomes final.

A. Amount or Extent of the Take

NMFS anticipates that the proposed action, as modified by the reasonable and prudent alternative, covered by this Biological Opinion has more than a negligible likelihood of resulting in incidental take of listed and proposed species because of potential impacts resulting from changes to the estuarine environment. Effects of actions such as this are largely unquantifiable, but are not expected to be measurable as long-term effects on the species' population levels. Therefore, even though the NMFS expects a level of incidental take to occur as the COE implements the project covered by this Biological Opinion, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take to the listed and proposed species themselves. In instances such as these, the NMFS designates the expected level of take as "unquantifiable." Based on the information in the BA, NMFS anticipates that an unquantifiable amount of incidental take could occur as a result of the proposed action covered by this Biological Opinion.

B. Reasonable and Prudent Measures

NMFS believes that the following reasonable and prudent measure(s) are necessary and appropriate to minimize take of listed and proposed listed anadromous salmonids in the Columbia River Basin:

1. Minimize incidental take associated with the interaction of channel deepening with the likely hydropower flow regulations through additional research.

2. Minimize incidental take associated with the potential reduction of suitable estuarine salmon habitat associated with the proposed action by restoring currently degraded estuarine salmon habitat.

3. Minimize incidental take associated with changes in salinity intrusion and concomitant changes in the estuarine food web by completing monitoring studies

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[5]At a meeting on July 20, 1999, between the NMFS Office of Protected Resources and the U.S. Fish and Wildlife Service Division of Endangered Species, representatives of both agencies agreed that the U.S. Fish and Wildlife Service (FWS) should exercise sole jurisdiction of the coastal cutthroat trout. FWS currently has jurisdiction and manages for freshwater populations of coastal cutthroat trout. In a September 28, 1999, meeting of field and regional level staff, FWS and NMFS agreed that FWS and NMFS would publish a joint Federal Register notice indicating such. Prior to the date the subject Federal Register notice is published, the responsibility for coastal cutthroat trout will remain with NMFS.

of salinity and food web effects and implementing the necessary measures to minimize impacts, if identified.

4. Develop and use best management practices to reduce the potential for incidental take associated with entrainment of juveniles.

5. Minimize incidental take associated with behavioral and sub-lethal effects from exposure to increased turbidity by analyzing sedimentation effects of potential spawning habitats in the estuary and implementing the necessary measures to minimize impacts, if identified.

6. Minimize incidental take associated with the potential redistribution of toxic contaminants by analyzing bioaccumulation effects of redistributed toxic contaminants in salmonids and implementing the necessary measures to minimize impacts, if identified.

7. Minimize the potential for incidental take associated with vessel wakes and for take resulting from modifications to nearshore habitat caused by vessel wakes by monitoring juvenile stranding and implementing the necessary measures to minimize impacts, if identified.

8. Report to NMFS annual progress toward implementing these reasonable and prudent measures.

C. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. In order to minimize incidental take associated with the interaction of channel deepening with potential hydropower flow regulations with regard to listed and proposed listings under the ESA, the Corps shall:

    a. Coordinate with the Hydropower Division of NMFS/Northwest Region in developing a research plan to determine the interrelated effects of channel deepening and proposed hydropower regulated flows, and implement the findings.

2. In order to minimize the incidental take associated with the potential reduction in availability of suitable estuarine habitat under ESA, the Corps, in collaboration with NMFS shall:

a. As part of the Corps' ecosystem restoration mission and responsibility under separate authority, independent of the Channel Improvement Project, expedite attainment of the objectives of the Lower Columbia River Estuary Program by restoring 1,500 acres of tidal wetlands by 2005, and 3000 acres between 2005 and 2010, subject to congressional authority and appropriation.

b. Expedite the re-establishment of 750 acres of tidal wetlands or other habitat that would contribute to macrodetrital production.

3. In order to minimize incidental take associated with changes in salinity intrusion and concomitant changes in the estuarine food web, the Corps shall:

   a. Develop appropriate indicators of physical and biological change for use in a long-term monitoring program and for the study described below.

   b. Complete a study on the biophysical and ecological effects of a deepened channel and any resultant salinity change on plant and animal communities and associated food web dynamics, with emphasis on rearing conditions at specific habitat locations and times that support juvenile salmonids and provide NMFS with a report by January 2002.

   c. As part of the above study, assess the extent to which channel deepening and flow regulation interact to affect salinity conditions and the manner in which juvenile use natural and restored estuarine habitats.

   d. Within 2 months of the completion of the required annual report, the Corps shall develop and implement measures (approved by NMFS) to minimize any identified impacts. NMFS will update this Biological Opinion with these additional terms and conditions by letter.

4. In order to reduce the potential for incidental take associated with entrainment of juveniles, the Corps shall:

   a. Place the discharge pipe deeper than 20 feet during flowlane disposal.

   b. Operate hydraulic dredges with the intake at or below the surface of the material being removed. The intake may be raised a maximum of three feet above the bed for brief periods of purging or flushing of the intake system. At no time would the dredge be operated at a level higher than three feet above the bed.

   c. Develop and implement a plan acceptable to NMFS to monitor potential juvenile salmon stranding in the lower Columbia River and provide NMFS with a report by January 2002.

d. In accordance with the biological opinion on operation and maintenance dredging, analyze potential dredge entrainment in shallow water areas maintained by the Corps and provide NMFS with a report by January 2002.

5. In order to minimize incidental take associated with behavioral and sub-lethal effects from exposure to increased turbidity, the Corps shall:

   a. Analyze potential impacts of increased sedimentation to spawning areas in the lower Columbia River and estuary as a result of increased dredging activities and provide NMFS with a report by January 2001.

   b. Analyze potential impacts of increased straying of returning adults to the Columbia River as a result of increased straying of returning adults to the Columbia River as a result of increased dredging activities and provide NMFS with a report by January 2002.

   c. Analyze potential impact of dredging on feeding activity and health of juvenile salmon in the lower Columbia River and estuary and provide NMFS with a report by January 2003.

   d. Within 2 months of the completion of the required annual report, the Corps shall develop and implement measures (approved by NMFS) to minimize any identified impacts. NMFS will update this Biological Opinion with these additional terms and conditions by letter.

6. In order to minimize incidental take associated with the potential redistribution of toxic contaminants, the Corps shall:

   a. Reassess, in consultation with NMFS, the potential impact of contaminants from redistribution by dredging activities, incorporating appropriate endpoints to derive realistic sediment quality standards and utilizing bioaccumulation potential from salmon-associated prey base as an additional source of transfer of contaminants to juvenile salmon. Provide NMFS with a report by January 2003.

   b. Within 2 months of the completion of the required annual report, the Corps shall develop and implement measures (approved by NMFS) to minimize any identified impacts. NMFS will update this Biological Opinion with these additional terms and conditions by letter.

7. In order to minimize potential for incidental take associated with vessel wakes and for take resulting from modifications to nearshore habitat caused by vessel wakes the Corps shall:

a. Develop and implement a plan to monitor juvenile stranding and utilization of nearshore habitat and provide NMFS with a report by January 2002.

b. Work with NMFS, the U.S. Coast Guard, and the river pilots to develop vessel speed limits that would reduce the potential for stranding of juvenile salmon from ship wakes and exacerbate riverbank erosion.

c. Within 2 months of the completion of the required annual report, the Corps shall develop and implement measures (approved by NMFS) to minimize any identified impacts.

8. Submit annual reports to NMFS on the status of the Corps' implementation of these terms and conditions of the above reasonable and prudent measures.

NMFS will update this Biological Opinion with these terms and conditions by letter as studies are conducted and implementation occurs.

ATTACHMENT 1

The Habitat Approach

Implementation of Section 7 of the Endangered Species Act for
Actions Affecting the Habitat of Pacific Anadromous Salmonids

Prepared by the National Marine Fisheries Service
Northwest Region
Habitat Conservation and Protected Resources Divisions
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I. PURPOSE

This document describes the analytic process and principles that the National Marine Fisheries Service (NMFS) Northwest Region (NWR) applies when conducting ESA § 7 consultations on actions affecting freshwater salmon[6] habitat.

II. BACKGROUND

Section 7 of the Endangered Species Act[7] (ESA) requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of their critical habitat.[8] Federal agencies must consult with National Marine Fisheries Service (NMFS) regarding the effects of their actions on certain listed species.[9] The NMFS evaluates the effects of proposed Federal actions on listed salmon by applying the standards of § 7(a)(2) of the ESA as interpreted through joint NMFS and U.S. Fish and Wildlife Service (FWS) regulations and policies.[10] When NMFS issues a biological opinion, it uses the best scientific and commercial data available to determine whether a proposed Federal action is likely to (1) jeopardize the continued existence of a listed species, or (2) destroy or adversely modify the designated critical habitat of a listed species.[11]

The Services' ESA implementing regulations define "jeopardize the continued existence of" to mean: "...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."[12] Section 7(a)(2)'s

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[6] For purposes of brevity and clarity, this document will use the word "salmon" to mean all those anadromous salmonid fishes occurring in, and native to, Pacific Ocean drainages of the United States – including anadromous forms of cutthroat and steelhead trouts, and not including salmonids occurring in Atlantic Ocean and Great Lakes drainages.

[7] 16 USC §§ 1531 *et seq*.

[8] 16 USC § 1536(a)(2) (1988).

[9]A 1974 Memorandum of Understanding between NMFS and FWS establishes that NMFS retains ESA jurisdiction over fish species that spend a majority of their lives in the marine environment, including salmon. *See* Memorandum of Understanding Between the U.S. Fish and Wildlife Service, United States Department of Interior, and the National Oceanic and Atmospheric Administration, United States Department of Commerce, Regarding Jurisdictional Responsibilities and Listing Procedures under the Endangered Species Act of 1973 (1974).

[10] *See* U.S. Fish and Wildlife Service and National Marine Fisheries Service., *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.* U.S. Government Printing Office, Washington, D.C. (1998).

[11] 16 USC § 1536(a)(2) (1988).

[12] 50 CFR § 402.02 (1999).

requirement that Federal agencies avoid jeopardizing the continued existence of listed species is often referred to as the "jeopardy standard."[13] The ESA likewise requires that Federal agencies refrain from adversely modifying designated critical habitat.[14] The Services' ESA implementing regulations define the term "destruction or adverse modification" of critical habitat to mean:

> . . . a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.[15]

A species is listed as endangered if it is in danger of extinction throughout all or a significant portion of its range.[16] A species is listed as threatened if it is likely to become endangered within the foreseeable future.[17] Listing a species under the ESA therefore reflects a concern for a species' continued existence—the concern is immediate for endangered species and less immediate, but still real, for threatened species. The purpose of the ESA is to provide a means whereby the ecosystems upon which listed species depend may be conserved, such that the species no longer require the protections of the ESA and can be delisted.[18] This constitutes "recovery" under the ESA.[19] Recovery, then, represents a state in which there are no serious concerns for the survival of the species.[20]

Impeding a species' progress toward recovery exposes it to additional risk, and so reduces its likelihood of survival. Therefore, in order for an action to not "appreciably reduce" the likelihood of survival, it must not prevent or appreciably delay recovery. Salmon survival in the wild depends upon the proper functioning of certain ecosystem processes, including habitat formation and maintenance. Restoring functional habitats depends largely on allowing natural processes to increase their ecological function, while at the same time removing adverse impacts

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[13] *See* M.J. Bean and M.J. Rowland, *The Evolution of National Wildlife Law. Third Edition.*Praeger Publishers, Westport, Connecticut, pp. 240, 253 & 260 (1997).

[14] 16 USC § 15536(a)(2) (1988).

[15] 50 CFR § 402.02 (1999).

[16] 16 USC § 1532(6) (1988).

[17] 16 USC § 1532(20) (1988).

[18] *See, e.g.*, 16 USC § 1532(3) (1988) (defining the term "conserve"); 16 USC § 1531 (b) (1988) (stating the purpose of the ESA).

[19] *See, e.g.*, 16 USC § 1533(f)(1) (1988) (describing the purpose of recovery plans).

[20] NMFS, *Memorandum from R.S. Waples, NMFS, to the Record* (1997).

of current practices.[21] Along these lines, the courts have recognized that no bright line exists in the ESA regarding the concepts of survival and recovery.[22] Likewise, available scientific information concerning habitat processes and salmon population viability indicates no practical differences exist between the degree of function essential for long-term survival and that necessary to achieve recovery.[23]

III. ORGANIZATION OF ENDANGERED SPECIES ACT § 7 ANALYSES

In conducting analyses of habitat-altering actions under § 7 of the ESA, NMFS uses the following steps: (1) Consider the status and biological requirements of the affected species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; (4) consider cumulative effects; (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild or adversely modify its critical habitat. If jeopardy or adverse modification is found, NMFS must identify reasonable and prudent alternatives to the action if they exist.

The analytical framework described above is consistent with the Services' joint ESA § 7 Consultation Handbook[24] and builds upon the Handbook framework to better reflect the scientific and practical realities of salmon conservation and management on the West Coast. Below we describe this analytical framework in detail.

A. Describe the Affected Species' Status and Define its Biological Requirements.

1. Identify the Affected Species and Describe its Status

The first step in conducting this analysis is to identify listed species, and when known, populations of listed species, that may be affected by the proposed action. Under the ESA, a taxonomic species may be defined as a "distinct population segment."[25] The NMFS has

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[21] Stouder et al., *Pacific Salmon and Their Ecosystems: Status and Future Options*, Chapman and Hall, New York, New York (1997).

[22] *Idaho Department of Fish and Game v. NMFS*, 850 F.Supp. 886 (D. OR 1994) (discussing NMFS' biological opinion concerning the Federal Columbia River Hydropower System).

[23] *See* 51 Fed. Reg. 19,926 (1982). In the preamble to the § 7 consultation regulations, the Services recognized that in some cases, no distinction between survival and recovery my exist, stating "If survival is jeopardized, recovery is also jeopardized...it is difficult to draw clear-cut distinctions" [between survival and recovery].

[24] *See* FWS and NMFS, *supra* note 5.

[25] 16 USC § 1532(16) (1988).

established a policy that describes such "distinct population segments" as Evolutionarily Significant Units (ESUs).[26] An ESU is a population or group of populations that is substantially reproductively isolated from other conspecific populations and represents an important component in the evolutionary legacy of the species.[27] In implementing the ESA, NMFS has established ESUs as the listing unit for salmon under its jurisdiction. Therefore, for purposes of jeopardy determinations, NMFS considers whether a proposed action will jeopardize the continued existence of the affected ESU or adversely modify its critical habitat.[28]

When affected species and populations have been identified, NMFS considers the relative status of the listed species, as well as the status of populations in the action area. This may include parameters of abundance, distribution, and trends in both. Various sources of information exist to define species and population status. The final rule listing the species or designating its critical habitat is a good example of this type of information. Species' status reviews and factors for decline reports may also provide relevant information for this section. When completed, recovery plans and associated reports will provide a basis for determining species status in the action area.

2. Define the Affected Species' Biological Requirements

The listed species' biological requirements may be described in a number of different ways. For example, they can be expressed in terms of population viability using such variables as a ratio of recruits to spawners, a survival rate for a given life stage (or set of life stages), a positive population trend, or a threshold population size. Biological requirements may also be described as the habitat conditions necessary to ensure the species' continued existence (*i.e.*, functional habitats) and these can be expressed in terms of physical, chemical, and biological parameters. The manner in which these requirements are described varies according to the nature of the action under consultation and its likely effects on the species.

However species' biological requirements are expressed—whether in terms of population variables or habitat components—it is important to remember that there is a strong causal link between the two: actions that affect habitat have the potential to affect population abundance, productivity, and diversity; these effects are particularly noticeable when populations are at low levels—as they are now in every listed ESU. The importance of this relationship is highlighted

[26] *See* 56 Fed. Reg. 58,618 (1991).

[27] R.S. Waples, *Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon*, National Marine Fisheries Service (1991).

[28] NMFS has recognized that in many cases ESUs contain a significant amount of genetic and life history diversity. Such diversity is represented by independent salmon populations that may inhabit river basins or major sub-basins within ESUs. In light of the importance of protecting the biological diversity represented by these populations, NMFS considers the effects of proposed actions on identifiable, independent salmon populations in judging whether a proposed action is likely to jeopardize the ESU as a whole.

by the fact that freshwater habitat degradation is identified as a factor of decline in every salmon listing on the West Coast.[29]

Habitat-altering actions continue to affect salmon population viability, frequently in a negative manner.[30] However, it is often difficult to quantify the effects of a given habitat action in terms of its impact on biological requirements for individual salmon (whether in the action area or outside of it). Thus it follows that while it is often possible to draw an accurate picture of a species' rangewide status—and in fact doing so is a critical consideration in any jeopardy analysis—it is difficult to determine how that status may be affected by a given habitat-altering action. Given the current state of the science, usually the best that can be done is to determine the effects an action has on a given habitat component and, since there is a direct relationship between habitat condition and population viability, extrapolate to the impacts on the species as a whole. Thus, by examining the effects a given action has on the habitat portion of a species' biological requirements, NMFS has a gauge of how that action will affect the population variables that constitute the rest of a species' biological requirements and, ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ESU levels, and effects on habitat should be readily quantifiable in terms of population impacts. In the absence of such information, NMFS' analyses must rely on generally applicable scientific research that one may reasonably extrapolate to the action area and to the population(s) in question. Therefore, for actions that affect freshwater habitat, NMFS usually defines the biological requirements in terms of a concept called properly functioning condition (PFC). Properly functioning condition is the sustained presence of natural[31] habitat-forming processes in a watershed (*e.g.,* riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats

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[29] *See, e.g.*, 57 Fed. Reg. 14,653 (April 22, 1992) (Snake River spring/summer and fall chinook); 62 Fed. Reg. 24,588 (May 6, 1997) (Southern Oregon/Northern California coho); 63 Fed. Reg. 13,347 (March 18, 1998) (Lower Columbia River and Central Valley steelhead).

[30] *See* NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[31] The word "natural" in this definition is not intended to imply "pristine," nor does the best available science lead us to believe that only pristine wilderness will support salmon. The best available science does lead us to believe that the level of habitat function necessary for the long-term survival of salmon (PFC) is most reliably and efficiently recovered and maintained by simply eliminating anthropogenic impairments, and does not usually require artificial restoration. *See* Rhodes et. al., *A Coarse Screening Process for Potential Application in ESA Consultations.* Columbia River Inter-Tribal Fish Commission, Portland, Oregon, pp. 59-61, (1994); National Research Council, *Upstream: Salmon and Society in the Pacific Northwest. National Research Council*, National Academy Press, Washington, D.C., p. 201 (1996).

on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

In the PFC framework, baseline environmental conditions are described as “properly functioning,” “at risk,” or “not properly functioning.” If a proposed action would be likely to impair[32] properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat or both, depending upon the specific considerations of the analysis. Such considerations may include for example, the species’ status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of the available information.

Since lotic[33] habitats are inherently dynamic, PFC is defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival. Although the indicators used to assess functioning condition may entail instantaneous measurements, they are chosen, using the best available science, to detect the health of underlying processes, not static characteristics. “Best available science” advances through time; this advance allows PFC indicators to be refined, new threats to be assessed, and species status and trends to be better understood. The PFC concept includes a recognition that natural patterns of habitat disturbance will continue to occur. For example, floods, landslides, wind damage, and wildfires will result in spatial and temporal variability in habitat characteristics, as will anthropogenic perturbations.

B. Evaluate the Relevance of the Environmental Baseline in the Action Area to the Species’ Current Status.

The environmental baseline represents the current basal set of conditions to which the effects of the proposed or continuing action would be added. It “includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early § 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.”[34]

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[32] In this document, to “impair” habitat means to reduce habitat condition to the extent that it does not fully support long-term salmon survival and therefore “impaired habitat” is that which does not perform that full support function. Note that “impair” and “impaired” are not intended to signify any and all reduction in habitat condition.

[33] Running water.

[34] *See* 50 CFR § 402.02 (1999) (definition of “effects of the action”). Action area is defined by the consultation regulations (50 CFR 402.02) as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.”

The environmental baseline does not include any future discretionary Federal activities (that have not yet undergone ESA consultation) in the action area. The species' current status is described in relation to the risks presented by the continuing effects of all previous actions and resource commitments that are not subject to further exercise of Federal discretion. For a new project, the environmental baseline consists of the conditions in the action area that exist before the proposed action begins. For an ongoing Federal action, those effects of the action resulting from past unalterable resource commitments are included in the baseline, and those effects that would be caused by the continuance of the proposed action are then analyzed for determination of effects.

The reason for determining the species' status under the environmental baseline (without the effects of the proposed or continuing action) is to better understand the relative significance of the effects of the action upon the species' likelihood of survival and chances for recovery. Thus if the species' status is poor and the baseline is degraded at the time of consultation, it is more likely that any additional adverse effects caused by the proposed or continuing action will be significant.

The implementing regulations specify that the environmental baseline of the area potentially affected by the proposed action should be used in making the jeopardy determination. Consequently, delineating the action area for the proposed or continuing action is one of the first steps in identifying the environmental baseline. For the lotic environs typical of salmon habitat-related consultations, a watershed or sub-basin geographic unit (and its downstream environs) is usually a logical action area designation. Most habitat effects are carried downstream readily, and many travel upstream as well (*e.g.*, channel downcutting). Moreover, watershed divides provide clear boundaries for analyzing the cumulative effects of multiple independent actions.[35]

C. Determine the Effects of the Action on the Species.

In this step of the analysis, NMFS examines the likely effects of the proposed action on the species and its habitat within the context of the its current status and existing environmental baseline. The analysis also includes an analysis of both direct and indirect effects of the action. "Indirect effects" are those that are caused by the action and are later in time but are still reasonably certain to occur. They include effects on species or critical habitat of future activities that are induced by the action subject to consultation and that occur after the action is completed. The analysis also takes into account direct and indirect effects of actions that are interrelated or interdependent with the proposed action. "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration.

NMFS may use either or both of two independent techniques in assessing the impact of a proposed action. First, NMFS may consider the impact in terms of how many listed salmon will

[35] National Research Council, *Upstream: Salmon and Society in the Pacific Northwest. National Research Council*, National Academy Press, Washington, D.C., pp. 34, 213 & 359 (1996).

be killed or injured during a particular life stage and gauge the effects of that take's effects on population size and viability. Alternatively, NMFS may consider the impact on the species' freshwater habitat requirements, such as water temperature, substrate composition, dissolved gas levels, structural elements, etc. This second technique is especially useful for habitat-related analyses because, while many cause and effect relationships between habitat quality and population viability are well known,[36] they do not lend themselves to meaningful quantification in terms of fish numbers. Consequently, while this second technique does not directly assess the effects of actions on population condition, it indirectly considers this issue by evaluating existing habitat conditions in light of habitat conditions known to be conducive to salmon conservation.

Though there is more than one valid analytical framework for determining effects, NMFS usually uses a matrix of pathways and indicators to determine whether proposed actions would further damage impaired habitat or retard the progress of impaired habitat toward properly functioning condition. For the purpose of guiding Federal action agencies in making effects determinations, NMFS has developed and distributed a document detailing this method.[37] This document is discussed in more detail below. The levels of effects, or effects determinations, are defined[38] as:

> **"No effect."** Literally no effect whatsoever. No probability of any effect. The action is determined to have "no effect" if there are no proposed or listed salmon and no proposed or designated critical habitat in the action area or downstream from it. This effects determination is the responsibility of the action agency to make and does not require NMFS review.
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> **"May affect, not likely to adversely affect."** Insignificant, discountable, or beneficial effects. The effect level is determined to be "may affect, not likely to adversely affect" if the proposed action does not have the potential to hinder attainment of relevant properly functioning indicators and has a negligible (extremely low) probability of taking proposed or listed salmon or resulting in the destruction or adverse modification of their habitat. An insignificant effect relates to the size of the impact and should never reach the scale where take occurs.[39] A "discountable effect" is defined as being so extremely unlikely to

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[36] *See* Spence et al., *An Ecosystem Approach to Salmonid Conservation*, ManTech Environmental Research Services Corporation, Corvallis, Oregon (1996).

[37] *See* NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[38] These definitions are adapted from those found in NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996), and; U.S. Fish and Wildlife Service and National Marine Fisheries Service., *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.* U.S. Government Printing Office, Washington, D.C. (1998)

[39] "Take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct." 16 USC §1532(19) (1988).

occur that a reasonable person cannot detect, measure, or evaluate it. This level of effect requires informal consultation, which consists of NMFS concurrence with the action agency's determination.

"May affect, likely to adversely affect." Some portion or aspect of the action has a greater than insignificant probability of having a detrimental effect upon individual organisms or habitat. Such detrimental effect may be direct or indirect, short- or long-term. The action is "likely to adversely affect" if it has the potential to hinder attainment of relevant properly functioning indicators, or if there is more than a negligible probability of taking proposed or listed salmon or resulting in the destruction or adverse modification of their habitat. This determination would apply when the overall effect of an action has short-term adverse effects even if the overall long-term effect is beneficial. In such instances, NMFS conducts a jeopardy analysis.

The above effects determinations are applicable to individual fish, including fry and embryos. The MPI should be applied at spatial scales appropriate to the proposed action so that its habitat effects on individuals are fully taken into account. For example, if any of the indicators in the MPI are thought to be degraded by the proposed action to the extent that take of an individual fish results, the action is determined to be "may affect, likely to adversely affect." For actions that are likely to adversely affect, NMFS must conduct a jeopardy analysis and render a biological opinion resulting in one of the conclusions below:

"Not likely to jeopardize" and/or "Not likely to result in the destruction or adverse modification of critical habitat." The action does not appreciably reduce the likelihood of species survival and recovery or result in the destruction or adverse modification of its critical habitat.

"Likely to jeopardize" and/or "Likely to result in the destruction or adverse modification of critical habitat." The action appreciably reduces the likelihood of species survival and recovery or results in the destruction or adverse modification of its critical habitat.

D. Consider Cumulative Effects in the Action Area.

The ESA implementing regulations define "cumulative effects" as those effects caused by future projects and activities unrelated to the action under consideration (not including discretionary Federal actions) that are reasonably certain to occur within the action area.[40] Since all future discretionary Federal actions will at some point be subject to § 7 consultation, their effects will be considered at that time and are not included in cumulative effects analysis.

E. Jeopardy Determinations.

[40] 50 CFR § 402.02 (1999).

In this step of the analysis, NMFS determines whether (a) the species can be expected to survive, with an adequate potential for recovery, under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects; and (b) whether the action will appreciably diminish the value of critical habitat for both the survival and recovery of the species. In completing this step of the analysis, NMFS determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the continued existence of the listed species or result in destruction or adverse modification of critical habitat.

For the jeopardy determination, NMFS uses the consultation regulations and the MPI analysis method to determine whether actions would further degrade the environmental baseline or hinder attainment of PFC at a spatial scale relevant to the listed ESU. That is, because salmon ESUs typically consist of groups of populations that inhabit geographic areas ranging in size from less than ten to several thousand square miles (depending on the species), the analysis must applied at a spatial resolution wherein the actual effects of the action upon the species can be determined.

The analysis takes into account the species' status because determining the impact upon a species' status is the essence of the jeopardy determination. Depending upon the specific considerations of the analysis, actions that are found likely to impair currently properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale will generally be determined likely to jeopardize the continued existence of listed salmon, adversely modify their critical habitat, or both. Specific considerations include whether habitat condition was an important factor for decline in the listing decision, changes in population or habitat conditions since listing, and any new information that has become available.

If NMFS anticipates take of listed salmon incidental to the proposed action, the biological opinion is accompanied by an incidental take statement with reasonable and prudent measures to minimize the impact of such take, and non-discretionary terms and conditions for implementing those measures. Discretionary conservation recommendations may also accompany the biological opinion to assist action agencies further the purposes of habitat and species conservation specified in §§ 7(a)(1) and 7(a)(2).

F. Identify reasonable and prudent alternatives to a proposed or continuing action that is likely to jeopardize the continued existence of the listed species.

If the proposed or continuing action is likely to jeopardize the listed species or destroy or adversely modify critical habitat, NMFS must identify reasonable and prudent alternatives that comply with the requires of § 7(a)(2) and with the applicable regulations. The reasonable and prudent alternative must be consistent with the intended purpose of the action, consistent with the action agency's legal authority and jurisdiction, and technologically and economically feasible. At this stage of the consultation, NMFS will also indicate if it is unable to develop a reasonable and prudent alternative.

IV. APPLICATION TOOLS USEFUL IN CONDUCTING § 7 ANALYSES - THE MATRIX

As previously mentioned, NMFS has developed an analytic methodology to help determine the environmental effects a given action will have by describing an action's effects on PFC.[41] This document includes a *Matrix of Pathways and Indicators* (MPI; often called "The Matrix,") and a dichotomous key for making effects determinations based on the condition of the environmental baseline and the likely effects of a given project. The MPI helps the action agency and NMFS describe current freshwater habitat conditions, determine the factors limiting salmon production, and identify sensitive areas and any risks to PFC. This document only *helps* make effects determination, it does not describe jeopardy criteria per se.

The pathways for determining the effects of an action are represented as six conceptual groupings (*e.g.*, water quality, channel condition, and dynamics) of 18 habitat condition indicators (*e.g.*, temperature, width/depth ratio). Default indicator criteria[42] (mostly numeric, though some are narrative) are laid out for three levels of environmental baseline condition: properly functioning, at risk, and not properly functioning. The effects of the action upon each indicator is classified by whether it will restore, maintain, or degrade the indicator.

The MPI provides a consistent, but geographically adaptable, framework for effects determinations. The pathways and indicators, as well as the ranges of their associated criteria, are amenable to alteration through the process of watershed analysis. The MPI, and variations on it, are widely used in § 7 consultations. The MPI is also used in other venues to determine baseline conditions, identify properly functioning condition, and estimate the effects of individual management prescriptions. This assessment tool was developed for forestry activities. NMFS is working to adapt it for other types of land management, and for larger spatial and temporal scales.

For practical purposes, the MPI analysis must sometimes be applied to geographic areas smaller than a watershed or basin due to a proposed action's scope or geographic distribution. These circumstances necessarily reduce analytic accuracy because the processes essential to aquatic habitats extend continuously upslope and downslope, and may operate quite independently between drainages.[43] Such loss of analytic accuracy should typically be offset by more

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[41] NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[42] The unmodified "matrix" uses ranges of values for indicators that are generally applicable between species and across the geographic distribution of salmon. The indicators can be, and have been, modified for more specific geographic and species applications.

[43] L. B. Leopold, *A View of the River*, Harvard University Press, Cambridge, Massachusetts, chapter 1 (1994).

conservative management practices in order to achieve parity of risk with the watershed approach. Conversely, a watershed approach to habitat conservation provides greater analytic certainty, and hence more flexibility in management practices.

V. CONCLUSION

The NMFS has followed regulations under sections 7 and 10 of the ESA to develop an analytical procedure used to consistently assess whether any proposed action would jeopardize or conserve federally protected species. There is a legacy of a more than a century of profound human alterations to the Pacific coast drainages inhabited by salmon.[44] The analytical tool described as the MPI enables proposed actions to be assessed in light of the species current status, the current conditions, and expected effects of the action. Proposed actions that fail to conserve fish and their habitats as initially proposed can be redesigned to avoid jeopardy and begin to restore watershed processes. Conservation of listed salmon will depend largely on the recovery of watershed processes that furnish their aquatic habitat.

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[44] *See* Cone and Ridlington, *The Northwest Salmon Crisis, a Documentary History*. Oregon State University Press, Corvallis, Oregon, pp. 12-21 & 154-160 (1996); W. Nehlsen *et al.*, *Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington*, Fisheries, Vol.16(2), pp. 4-21 (1991).